

Comments on DOE's 1605b Voluntary Greenhouse Gas Reporting System's Accounting Rules and Guidelines for Agriculture Greenhouse Gas Activities

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Agriculture is a critical component of our society and economy through the provision of food and fiber. Agriculture also represents a significant opportunity for greenhouse gas mitigation projects through soil carbon sequestration and reductions of methane (CH₄) and nitrous oxide (N₂O) emissions. Projects that result in soil carbon sequestration and reductions in CH₄ and N₂O emissions often result in compound environmental benefits through improved soil structure which in turn can improve air and water quality. Based on recent EPA emission inventories, agricultural sources of annual CH₄ and N₂O emissions exceed 300 Tg CO₂ eq., representing close to 4.5% of total US emissions. Soil management-induced N₂O emission is the largest source, accounting for over 97% of total agricultural emissions.

It is well known that carbon sequestration will inherently increase N₂O (in upland soils) and CH₄ (in wetland soils) emissions due to the coupling of carbon and nitrogen biogeochemical cycles. Thus, the net offset between reductions in atmospheric CO₂ and increases in atmospheric CH₄ and N₂O can be significant, and in some cases can result in a net increase in atmospheric CO₂ equivalents. Therefore, assessing the efficacy of carbon sequestration projects in forestry and agriculture must include comprehensive analyses that examine the impacts of management decisions on all greenhouse gases. The scientific community is somewhat split on the current state of knowledge on estimating emissions of N₂O from agricultural soils. Many scientists now feel that the biogeochemical processes that control N₂O emissions are well known and availability of sufficient data on soils and management practices limits our ability to accurately estimate N₂O emissions at site and regional scales. Conversely, some scientists still believe that we do not have a sufficient understanding of these biogeochemical processes to estimate N₂O emissions. Nevertheless, it is clear that biogeochemical processes that control CH₄ and N₂O emissions from agroecosystems, like denitrification, nitrification, decomposition and fermentation, are non-linearly coupled with anthropogenic and ecological drivers that are highly variable in space and time. As a result, static default emission factors (EFs) cannot capture this variability without development of detailed site and management specific EFs. In addition, EFs typically do not provide estimates of uncertainties particular to a set of conditions, a key requirement for assessing the effectiveness of mitigation options. For example, while the IPCC default factor approach of estimating fertilizer induced N₂O emissions as 1.25±1.0% of total N-fertilizer use may be suitable for national level inventories, it is not well suited for project, site and regional level inventories. Field measurements demonstrated that the factor could vary from <0.001 to 6.8% (Eichner 1990; Bouwman 1995) due to the collective effects of numerous factors such as climate, soil properties, crop type and rotation, and various cropping practices. Process-based models have been developed to handle the complexity. Recently, a group of Canadian researchers compared agricultural N₂O emissions predicted with the IPCC approach and a biogeochemical model against field observations, and found the model-predicted N₂O fluxes provided a significantly better estimate of the observed fluxes (Smith et al., 2002).

Therefore, given the difficulties and expense associated in continuous measurement of CH₄ and N₂O, project level estimation and accounting methods must rely on models, either directly or indirectly through model derived site specific emission factors. GIS based process models are now mature and scientifically sound enough to simulate spatially heterogeneous conditions that control temporal and spatial patterns of greenhouse gases (GHG) and, hence, could be critical component of the DOE Voluntary Greenhouse Gas Reporting Program (VGGRP) for project level reporting. In particular, the role of models in VGGRP could be to:

- compare and evaluate alternative management practices,
- improve the utility of default factors by creating site and management specific emission factors that significantly improve emission estimates,
- assess co-impacts of management decisions (e.g. coupling between carbon sequestration and emissions of CH₄ and N₂O),
- simulate long-term permanence of mitigation efforts,
- highlight the tight coupling of carbon and nitrogen biogeochemical cycles,
- develop baselines for quantifying net effects of management decisions, and
- provide comprehensive impact assessment beyond GHG emission mitigation through simulation of nutrient life cycles .

While from the perspective of VGGRP, it may be more straightforward to provide a system for registering projects that account for carbon sequestration alone, nevertheless the VGGRP system needs to have capabilities and tools for complete greenhouse gas accounting utilizing current state of knowledge tools. Current plans for using separate default emission factors for CH₄ and N₂O emissions for each of Land Resource Regions in the US represents an improvement from the IPCC approach. However, since potential reporters to the VGGRP typically have data needed for improved model-based estimates of CH₄ and N₂O emissions, namely soil conditions, local climate and management practices, the VGGRP should consider enhancing the tools for estimating carbon sequestration and CH₄ and N₂O emissions by creating more geographically refined factors that compensate for within region variability in soil conditions and management practices. As the VGGRP system evolves, state of the art modeling tools could be developed and provided to reporting entities to improve carbon sequestration and greenhouse gas emission estimates.

Thank you for the opportunity to provide comments on technical issues related to the DOE's 1605b voluntary greenhouse gas reporting system.

References

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